Entropy, Gaia and the Invisible Hand

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Summary

A basic economic model is presented that shows many emergent features seen in real world economies. These features include personal distributions of wealth and income, and macroeconomic income shares, as well as distributions of company sizes.

The models are stock-flow consistent, dynamic ABM models. They were partly inspired by the work of Ayres & Nair, as well as standard finance and physics theory. The models include elements from the economics of the classical economists, and are strongly influenced by the work of Sraffa, Minsky and Godley.

Derived from these models, an asset-based welfare system is discussed which can provide a universal basic income even under zero growth conditions.

All the models are in steady-state equilibrium and resemble 'Maximum Entropy Production' ecological models.

As such, the models suggest that economic systems can be considered to be maximum entropy production systems that are sub-systems of the world ecological system as a whole – entropy, Gaia and the invisible hand are all essentially the same thing.

Abstract

A basic economic model is presented that shows many emergent features seen in real world economies. It is also shown that this economic model naturally forms a special subset of a larger world ecological system.

Although the basic model was derived from an econophysics, statistical mechanics approach. The model builds on the work of Levy & Solomon [1] who extended the biological Lotka-Volterra model in to a generalised statistical model that gives a stable distribution for multiple, hetrogenous agents that can be both predators and prey.

However the model philosophy was strongly influenced by work of Ayres & Nair [2]. In 1982 Ayres & Nair observed that economic circulation diagrams do not comply with the realities of the physical flow of materials. The base model described in this paper combines material entropic flows and financial flows in a meaningful manner that fully meets these objections.

The models use standard finance and physics theory, along with elements from the economics of the classical economists. The models are also stock-flow consistent circuits in the manner of Wynne Godley, Steve Keen and other post-Keynesians. In particular, at their core the models combine real capital flows in the manner of the 'corn' models of Sraffa, with the valuation of financial capital on revenue stream described by Minsky.

From this modelling base, a series of models are reviewed that model economies as

statistical-mechanical, dynamic, flow systems. While the models are simple steady state models, they are robust and give many outputs seen in real world economies.

The models give full explanations for the distributions of waged earnings, distributions of wealth, and distributions of returns to capital. From these input distributions, distributions of total income are explained. As such the models explain the ubiquity of severe inequality in capital based societies.

The models also give realistic distributions for company sizes.

The models give a full explanation for the ratio of macroeconomic shares of returns to labour and capital – one of Kaldor's facts, and give simple equations linking the macroeconomic labour share to personal income distribution. The models give a direct link from increasing debt to increasing inequality and increasing financial fragility.

Derived from these models, an assisted saving, asset-based welfare system is discussed. The system uses protected capital and is somewhere between a pension scheme and a personal investment account. It is demonstrated that such a system can provide a universal basic income that effectively eliminates poverty, with minimal taxation, even under zero growth conditions.

The presentation then discusses the role of entropy in producing 'dissipative structures': structures that assist in overall entropy production, despite being low entropy structures in their own right.

The ecological models of Kleidon, Lorenz, Paltridge, Dewar, Ackland & Gallagher [3, 4, 5 &6], and others are discussed. This work shows that climate system, oceanic circulation, and ecological systems are in fact 'dissipative structures' that can be mathematically modelled as 'Maximum Entropy Production' systems.

This concept of 'Maximum Entropy Production' is extended and combined with the insights of Ayres & Nair, and it is shown that, along with individual mines and factories, whole economic systems should also be considered to be 'Maximum Entropy Production' 'dissipative structures'.

All the models discussed in this paper fit the maximum entropy production principle, and show high levels of stability. So, even though they are 'non-equilibrium' models from a classical thermodynamic viewpoint, they are clearly in a steady-state equilibrium. As such these models form solutions to out of equilibrium thermodynamic systems.

As these economic systems are clearly sub-systems of the world's maximum entropy producing ecological system as a whole, it is shown that entropy, Gaia and the invisible hand are all essentially the same thing.

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